U.S. PATENT APPLICATION OF

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ENTITLED

"ENCLOSURE MEMBER, AND MULTI-LINK CONVEYOR CHAIN"

FILED HEREWITH ON MARCH 1, 2002

Express Mail Label No. EL889189559US
Date of Deposit March 1, 2002
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TITLE: ENCLOSURE MEMBER, AND MULTI-LINK CONVEYOR CHAIN

[0001] This application claims the benefit of priority of foreign patent application 0106190.2 filed in the United Kingdom on March 14, 2001, the complete disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a multi-link conveyor chain which may be used (for example) in the glass industry, in particular to an enclosure member for protecting the integrity of the multi-link conveyor chain during use and to a method for manufacturing the multi-link conveyor chain incorporating said enclosure member.

2. Description of the Related Art

[0003] Multi-link conveyor chains are in widespread use in the glass industry for transporting glass products between processing stations. For example, a multi-link conveyor chain which is typically 100 feet long may be used to transport blown glass from a blowing station to an annealing station. In the conventional multi-link conveyor chain, there is a plurality of parallel spaced apart elongate pins having an oval-shaped cross-section. Mounted on adjacent elongate pins are a series of link plates spaced apart along the pin by a plurality of washers, each link plate comprising a first link and a second link. Each of the first link and second link is capable of engaging a drive sprocket and has an oval-shaped aperture for receiving the elongate pin. The washer is typically a circular plate with a central circular aperture for

receiving the pin. The primary function of the washer is to act as a spacer which permits heat to be blown through the multi-link conveyor chain to maintain the temperature of transported hot glass articles. The multi-link conveyor chain is driven by the engagement of the links of the link plate with the multiple teeth of a drive sprocket during a cycle of engagement.

[0004] The conventional multi-link conveyor chain is assembled so that each end of the elongate pin extends beyond the outermost link plate (*ie* beyond the edge of the flat conveyor surface) and a pin head is fixed in a conventional manner to each exposed end. A disadvantage of this arrangement is that unless the guide strip adjacent to the multi-link conveyor chain is in perfect alignment with the edge of the multi-link conveyor chain, there is a tendency for the pin head to wear and eventually shear off so that the elongate pin may becomes dislodged. In extreme cases, this results in total collapse of the multi-link conveyor chain.

SUMMARY OF THE INVENTION

[0005] The present invention seeks to improve multi-link conveyor chains by enclosing one or both ends of an elongate pin in a protective enclosure member (*eg* a head protector). Moreover, the manufacture of such a multi-link conveyor chain enclosing both ends of an elongate pin in an enclosure member leads to particular difficulties which may be overcome in accordance with the present invention.

[0006] Thus viewed from one aspect the present invention provides a multi-link conveyor chain adapted to provide a substantially flat horizontal

surface driveable between a first processing station and a second processing station by engagement with a drive sprocket. The multi-link conveyor chain comprises a plurality of elongate pins spaced apart in substantially parallel relationship including a first elongate pin adjacent to a second elongate pin, each of said elongate pins having a first end, a second end and a non-circular section. The first end of each elongate pin extends beyond a first edge of the substantially flat horizontal surface. The multi-link conveyor chain further comprises a plurality of link plates mounted on adjacent elongate pins. The link plates have a first link connected to a second link by a connecting portion. The first link and the second link each have a main body and a circumferentially dependent sprocket engaging member, the main body defining a non-circular aperture whose shape essentially matches the non-circular section of an elongate pin. The multi-link conveyor chain further comprises a first enclosure member positioned at the first edge of the substantially flat horizontal surface. The first enclosure member comprises a main body having a substantially trapezoidal section and defining a first non-circular aperture and a second non-circular aperture. The shape of the first non-circular aperture and the second non-circular aperture essentially matches the non-circular section of the first elongate pin and second elongate pin respectively. The depth of the first and second non-circular apertures is sufficient to enclose the first end of the first elongate pin and of the second elongate pin respectively. Means are provided for retaining the first end of the

first elongate pin and the second elongate pin in the first and second non-circular aperture respectively.

[0007] In a preferred embodiment, the second end of each elongate pin extends beyond a second edge of the substantially flat horizontal surface and the multi-link conveyor chain further comprises a second enclosure member positioned at the second edge of the substantially flat horizontal surface. The second enclosure member comprises a main body having a substantially trapezoidal section and defining a first non-circular aperture and a second non-circular aperture. The shape of the first and second non-circular apertures essentially matches the non-circular section of the first elongate pin and the second elongate pin respectively. The depth of the first and second non-circular apertures is sufficient to enclose the second end of the first elongate pin and the second end of the second elongate pin respectively. Means are provided for retaining the second end of the first elongate pin and the second end of the second elongate pin in the first and second non-circular apertures respectively.

[0008] Generally speaking, the first and second enclosure member will be identical.

[0009] By enclosing the first end of the elongate pin in a first enclosure member (and preferably the second end in a second enclosure member), the integrity of the multi-link conveyor chain is advantageously protected. In other words, the tendency for a pin head exposed beyond the edge of the conveyor surface to be sheared off is eliminated.

[0010] In a particularly preferred embodiment, the multi-link conveyor chain comprises a plurality of enclosure members as hereinbefore defined positioned at the first and second edges of the substantially flat horizontal surface so as to enclose the first and second ends of each of the plurality of elongate members.

[0011] In a preferred embodiment, the substantially trapezoidal section of the first enclosure member has a first side substantially parallel to a second side, wherein the second side is longer than the first side and has rounded corners. Preferably the first side has rounded corners (typically to a lesser extent than the second side). In use, the first enclosure member is positioned at the first edge with the second side uppermost.

[0012] In a preferred embodiment, the means for retaining comprises: a first pin head secured to the first end of the first elongate pin and a second pin head secured to the first end of the second elongate pin, said first and second pin head being seated in a counterbore in the first and second non-circular aperture of the first enclosure member respectively. Preferably the counterbore is non-tapered (*eg* cylindrical).

[0013] The enclosure member may be sized and configured so as to have a maximum radial extent which is equal to or less than adjacent link plates. This ensures that the enclosure member does not interfere with the substantially flat horizontal surface.

[0014] In a preferred embodiment, the main body of each of the first and the second link of a link plate defines a non-circular aperture whose shape

non-identically matches the non-circular section of the elongate pin. The non-identical match between the non-circular section of the elongate pin and the shape of the non-circular aperture defined by the main body of the link causes the link plate to be advantageously driven by the elongate pin throughout the cycle of engagement with the drive sprocket.

[0015] Preferably the multi-link conveyor comprises: a plurality of elongate pins spaced apart in substantially parallel relationship including a first elongate pin adjacent to a second elongate pin which is adjacent to a third elongate pin, each of said elongate pins having a first end, a second end and a non-circular section, wherein a plurality of link plates are consecutively mounted in a staggered fashion along the first, second and third elongate pin.

[0016] In a preferred embodiment, the circumferentially dependent sprocket engaging member of each of the first link and the second link of the link plate is substantially flat edged. Preferably each of the first link and the second link of the link plate has a flat-edged, substantially teardrop profile.

[0017] Link plates may be mounted consecutively along an elongate pin and spaced apart by one or more washers. The main body of the washer or each washer may define a circular or non-circular aperture. In a preferred embodiment of the invention, each washer comprises a main body defining a non-circular aperture for receiving the elongate pin whose shape essentially matches the non-circular section of the elongate pin. The essential match between the non-circular section of the elongate pin and the shape of the non-circular aperture defined by the main body of the washer renders the washer

advantageously stationary throughout the cycle of engagement with the drive sprocket.

[0018] In a particularly preferred embodiment, each washer comprises a main body defining a non-circular aperture for receiving the elongate pin whose shape essentially matches the non-circular section of the elongate pin and the main body of each of the first link and the second link of the link plate defines a non-circular aperture whose shape non-identically matches the non-circular section of the elongate pin whereby relative articulation between the washer and the link plate is thought to be responsible for an advantageous self cleaning effect.

[0019] In a particularly preferred embodiment, the non-circular aperture defined by the main body of the washer is an identical match (*ie* in shape and size) to the non-circular section of the elongate pin. This has the added advantage that debris is largely prevented from reaching the non-circular aperture defined by the link plate thereby preventing added wear between the aperture and the elongate pin.

[0020] Preferably the non-circular section of the elongate pin is substantially elliptical (or oval). Preferably the non-circular aperture defined by the main body of the (or each) link is substantially elliptical (or oval) with an enlarged side portion. Particularly preferably the enlarged side portion extends inwardly towards the connecting portion.

[0021] Preferably the non-circular aperture of the washer is substantially elliptical (or oval).

[0022] In a preferred embodiment, each washer comprises a substantially circular main body having one or more circumferential irregularities.

[0023] Advantageously, each circumferential irregularity extends away from the circumference to a sharp axial edge. A sharp axial edge has the advantage that it cuts into (and therefore breaks up) debris whereas a worn or radiussed edge simply rubs (and therefore accumulates) debris.

[0024] Preferably, each circumferential irregularity is a substantially triangular extension.

[0025] In a preferred embodiment, the washer has a plurality of circumferential irregularities. For example, the washer has three or more circumferential irregularities, preferably five or more circumferential irregularities, particularly preferably seven or more circumferential irregularities and especially preferably about ten circumferential irregularities.

[0026] The substantially circular main body of the washer having one or more circumferential irregularities may adopt any convenient non-circular profile such as a polygonal profile (*eg* triangular, square, etc) or a non-polygonal profile. Typically the non-circular profile is axially symmetrical.

[0027] A polygonal profile may comprise a multi-sided polygon with a triangular extension on one or more (preferably all) of the sides. Preferred is a polygonal profile comprising a decagon with triangular extensions on each side.

[0028] The washer is sized and configured so as to have a maximum radial extent which is less than adjacent links. This ensures that the washer does not interfere with engagement and disengagement of links with the drive sprocket during the cycle of engagement.

[0029] In a preferred embodiment of the invention, each washer is made from a heat treatable alloy steel which has a working temperature in excess of 350°C. In the glass industry, this has the added advantage that conveyor chains (which might typically reach 350°C) will undergo no loss of hardness and sharp axial edges will not be worn. An additional advantage of this material is that the difference in hardness between the washer and an adjacent link is sufficient to reduce any pre-disposition to "cold welding" (*ie* welding of an adjacent washer and link).

[0030] It is not intended that the present invention be limited to use in the glass industry. It is expected that the multi-link conveyor chain of the invention will be suitable in any industry which desires transportation between a first and a second station. For example, the multi-link conveyor chain of the invention could be used to transport automotive parts in the automotive industry.

[0031] Viewed from a further aspect the present invention provides an enclosure member as hereinbefore defined.

[0032] The enclosure member may be fitted to any type of multi-link conveyor chain, in particular those available from Pennine Industrial Equipment Limited (Huddersfield, England) such as their PREMIUM range. It

may be fitted to multi-link conveyor chains of ½ inch or 1 inch pitch being link only or link/washer assemblies of center guide, side guide or multi-guide type. In each case, it is preferred to fit first and second enclosure members at each end of an adjacent pair of elongate pins.

[0033] Viewed from a yet further aspect the present invention provides a method for manufacturing a multi-link conveyor chain as hereinbefore defined comprising the steps of:

(A) securing a first pin head to the first end of an elongate pin;

(B) inserting the second end of the elongate pin into the first non-circular aperture defined by the main body of the first enclosure member;

(C) inserting the second end of the elongate pin into the non-circular aperture defined by the first or second link of each of a plurality of link plates to a position where the first pin head is enclosed within the first non-circular aperture defined by the main body of the first enclosure member; and

(D) securing a second pin head to the second end of the elongate pin.

[0034] Steps (A) and (D) are typically carried out by spin rivetting. Materials suitable for spin rivetting are familiar to those skilled in the art (*eg* carbide). Typically, the pin head is oval-shaped.

[0035] Particularly preferably, in step (C) the second end of the elongate pin is inserted to a position where the first pin head is seated in a counterbore in the first non-circular aperture.

[0036] Whilst it is relatively straightforward to enclose the first end of an elongate pin in the first enclosure member and thereafter to secure a

second pin head to a free second end of the elongate pin using the method of the invention, it is less straightforward to secure a second pin head to the second end of the elongate pin when the second end is fitted with a second enclosure member. This is due to the space constraints imposed on the second pin head by the non-circular aperture in the second enclosure member.

[0037] Thus in a preferred embodiment of the method of the invention, in step (C) the elongate pin is inserted to a position where the first pin head is seated in a counterbore in the first non-circular aperture of the first enclosure member, said method further comprising:

(E) inserting the second end of the elongate pin into the first non-circular aperture defined by the main body of the second enclosure member to a position where the second end is enclosed within the first non-circular aperture; and

(F) eccentrically spin rivetting a piece of material (*eg* carbide) onto the second end of the elongate pin to produce a second pin head.

[0038] Preferably, in step (E) the elongate pin is inserted to a position in which the second end is adjacent a counterbore. In this embodiment, step (F) produces a second pin head seated in the counterbore.

[0039] Preferably, the piece of material in step (F) is greater in diameter than the desired diameter of the second pin head. Typically the second pin head is oval and the desired diameter is the length of the major axis. By way of example, where the desired diameter is between 6.0 and 6.3mm and the counterbore is of 6.5mm diameter, a piece of carbide of

diameter 6.3mm is spin rivetted at an eccentricity of about 0.05mm to produce a second pin head seated in the counterbore.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] The accompanying drawings, which are incorporated in and constitute part of the specification, illustrate presently preferred embodiments and methods of the invention and, together with the general description given above and the detailed description of the preferred embodiments and methods below, serve to explain the principles of the invention. In the accompanying drawings:

[0041] Figure 1 illustrates an embodiment of the enclosure member of the invention; and

[0042] Figure 2 illustrates an embodiment of the multi-link conveyor assembly of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS AND PREFERRED METHODS OF THE INVENTION

[0043] Figure 1 illustrates an embodiment of the enclosure member of the invention designated generally by reference numeral 1. The enclosure member 1 comprises a trapezoidal main body 2 having a long side 3 parallel to a short side 4. The corners 3a and 3b of the long side 3 are rounded off (and to a lesser extent so are the corners 4a and 4b of the short side 4). The main body 2 defines a first non-circular aperture 5 and a second non-circular aperture 6, each of which are elliptical and provided with a cylindrical counterbore 5a and 6a respectively.

[0044] Figure 2 illustrates in partial view an embodiment of the multi-link conveyor chain of the invention designated generally by reference numeral 11. For the sake of clarity, the elongate pins and washers are omitted from Figure 2 (nevertheless it will be readily apparent how and where these are used).

[0045] The multi-link conveyor chain 11 provides a flat surface 12 upon which may be carried articles such as glass bottles to a processing station. The multi-link conveyor chain 11 comprises a series of elongate pins of elliptical section upon which are mounted a number of link plates 14. Each pair of consecutive link plates (16 and 17 for example) is spaced apart along an elongate pin by a washer. Link plates (16, 17 and 18 for example) are mounted consecutively in a staggered fashion along a first, second and third elongate pin.

[0046] Each of the plurality of link plates 14 has twin links 14a, 14b having a substantially teardrop profile which extends into a flat-edged, sprocket engaging tooth 14c. Each link 14a, 14b is connected by a connecting portion 32. A non-circular aperture 30 in link 14a non-identically matches the elliptical section of an elongate pin. The aperture 30 is substantially elliptical with an enlarged side portion 30a extending inwardly towards connecting portion 32.

[0047] To assemble the multi-link conveyor chain of Figure 2, the first end of each of a pair of elongate pins of elliptical section is fitted with a first pin head (by spin rivetting). The second end of each of the pair of elongate

pins is inserted into the first and second elliptical apertures 5 and 6 (respectively at positions A and B) of a first enclosure member 41 and through the plurality of link plates to a position in which the first pin heads are seated in the counterbores 5a and 6a respectively. The second end of each of the pair of elongate pins extends beyond the outermost link plate and is inserted into the first and second elliptical apertures 5 and 6 respectively of a second enclosure member 40. Each enclosure member 40 and 41 is as hereinbefore described with reference to Figure 1 (and the numbering where appropriate is retained). The second end of each of the pair of elongate pins is secured with a pin head seated in the counterbore 5a and 6a. This may be produced by eccentrically spin riveting a piece of carbide as hereinbefore described to the second end of the elongate pin within the counterbore. In this manner, the ends of each elongate pin may be protected using first and second enclosure members.

[0048] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative devices and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.